A person-centred segmentation study in elderly care: Towards efficient demand-driven care

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ABSTRACT

Providing patients with more person-centred care without increasing costs is a key challenge in healthcare. A relevant but often ignored hindrance to delivering person-centred care is that the current segmentation of the population and the associated organization of healthcare supply are based on diseases. A person-centred segmentation, i.e., based on persons' own experienced difficulties in fulfilling needs, is an elementary but often overlooked first step in developing efficient demand-driven care. This paper describes a person-centred segmentation study of elderly, a large and increasing target group confronted with heterogeneous and often interrelated difficulties in their functioning. In twenty-five diverse healthcare and welfare organizations as well as elderly associations in the Netherlands, data were collected on the difficulties in biopsychosocial functioning experienced by 2019 older adults. Data were collected between March 2010 and January 2011 and sampling took place based on their (temporarily) living conditions. Factor Mixture Model was conducted to categorize the respondents into segments with relatively similar experienced difficulties concerning their functioning. First, the analyses show that older adults can be empirically categorized into five meaningful segments: feeling vital; difficulties with psychosocial coping; physical and mobility complaints; difficulties experienced in multiple domains; and feeling extremely frail. The categorization seems robust as it was replicated in two population-based samples in the Netherlands. The segmentation's usefulness is discussed and illustrated through an evaluation of the alignment between a segment's unfulfilled biopsychosocial needs and current healthcare utilization. The set of person-centred segmentation variables provides healthcare providers the option to perform a more comprehensive first triage step than only a disease-based one. The outcomes of this first step could guide a focused and, therefore, more efficient second triage step. On a local or regional level, this person-centred segmentation provides input information to policymakers and care providers for the demand-driven allocation of resources.

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1. Introduction

A more person-centred approach in providing healthcare is being promoted in many Western developed countries (Taylor et al., 2010). Person-centred care involves striking a better balance between patients' needs and their consumption of scarce healthcare supplies, and is associated with individualized treatment, patient education and empowerment, and shared decision-making (Mead and Bower, 2000; Auerbach, 2001; Kiesler and Auerbach, 2006; Rijckmans et al., 2007). However, providing person-centred care through the ad-hoc customization of care for each individual would be extremely costly and time consuming (Lynn et al., 2007). Therefore, the necessity is to determine persons' felt difficulties in fulfilling their basic biopsychosocial needs on a group basis (Plsek and Wilson, 2001; Boult and Wieland, 2010), with each group being sufficiently homogenous and having adequate volume in some of the important aspects that are to be managed (Lillrank et al., 2010). If such groups can be identified, the supply system may be arranged according to such need-based groups (Jordan et al., 1998; Edvardsson et al., 2008), enabling the creation of a flexible demand-driven healthcare system. The degree of person-centred care will largely depend on how well the levels of biopsychosocial need fulfilment that persons experience are reflected in the segmentation, and these experienced levels of needs fulfilment are considered an essential basis for developing

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customized supply. In our focus on human beings' basic bio-psychosocial need, we draw on human motivation theory (Maslow, 1943; Alderfer, 1969) that defines needs as the motivation for achieving a satisfactory level of functioning as a human being. Needs can be further differentiated into 'unfulfilled needs' i.e., a person does experience difficulties and complaints in their functioning, whether or not help is given and 'fulfilled needs' i.e., a person does experience no or moderate difficulties and complaints in their functioning, also whether or not help is given (Phelan et al., 1995; Slade et al., 1996). Although the healthcare population is almost as diverse as the population at large, there have only been very limited attempts to segment this population based on experienced needs fulfilment (Calkins and Sviokla, 2007). The World Health Organization's International Classification of Diseases is the best-known classification system, but this groups diseases rather than persons, and is based on objective clinical judgements, not on personally felt needs (Lillrank et al., 2010; Sanderson and Mountney, 1997).

Indeed healthcare systems appear to be most commonly designed around diseases and other clinical conditions (e.g., the breast cancer clinical path) or around the provider whose services the patients might need (e.g., the cancer clinic). More generally, healthcare systems are predominantly based on professionals' appraisal of patients' healthcare needs (i.e., outsider perspective) rather than on patients' own felt difficulties and complaints in their functioning as a human being (i.e., insider perspective) (Bate and Robert, 2006). This results in a fragmented supply of healthcare, and an inefficient use of scarce resources (Lillrank et al., 2010; Lynn et al., 2007). In order to initiate the transition from a supply-oriented, fragmented and reactive system towards a flexible, demand-driven organization of care, it is necessary to re-examine the variables on which a population's segmentation in healthcare is based (Lynn et al., 2007).

In this article, we show how a segmentation based on the experienced difficulties in biopsychosocial needs fulfilment results in the identification of robust segments. The chosen population, i.e., the target market, for this research are the elderly. Older adults are consuming an increasing share of the available healthcare resources (Lafortune et al., 2009a), especially in late age and close to mortality (Forma et al., 2009). The relative and absolute growth of this section of the population, and the many and heterogeneous difficulties and complaints they experience in their functioning, make it vital to identify possible commonalities in these difficulties and complaints. Moreover, as heterogeneous as their experienced difficulties and complaints may appear, these also seem to be highly interrelated (Boult and Wieland, 2010; Fried et al., 2001; Slaets, 2006). This increases the likelihood of finding commonalities in their experienced difficulties in fulfilling biopsychosocial needs.

The first contribution of this paper is to provide a set of person-centred segmentation variables that could provide a better starting point than diseases for offering person-centred care. We label these as person-centred segmentation variables to reflect the focus on the whole person rather than adopting a disease orientation. The second contribution is the empirical identification and description of robust, person-centred groups of older adults. Third, we illustrate the usefulness of this segmentation through an evaluation of the alignment between the resulting segments' experienced difficulties in fulfilling biopsychosocial needs and their current utilization of healthcare provision.

2. Background

2.1. The need concept applied

The concept of need has been difficult to define (Meadows et al., 2000; Marshall, 1994), which has contributed to a wide range in conceptualizations and in approaches used to assess need at both individual and population levels (Aoun et al., 2004). Aoun et al. (2004) noted that the meaning and connotations of need depend not only on the context in and the purpose for which they are applied, but also on the discipline involved (p. 33). Cohen and Eastman (1997, p. 142) argue that different perspectives on need are viable, that they are complementary, and that there is no single truth about the concept of need. Therefore, we here clarify and position our conceptualization of the term need. In line with human motivation theory (Maslow, 1943; Alderfer, 1969), we focus on human beings basic biopsychosocial needs, which are defined as the motivation for achieving a satisfactory level of functioning as a human being. The underlying theoretical assumption is that all people have biopsychosocial needs, which motivate them to do something about it, and that the fulfilment of these needs determines their well-being (Maslow, 1943; Alderfer, 1969; Acton and Malathum, 2000; Tay and Diener, 2011).

This basic need definition departs from some other concepts of need in four ways. First, we concentrate on felt needs as opposed to expressed, normative, and comparative need concepts (Bradshaw, 1994); More specifically, we look at unfulfilled felt needs in terms of what people experience themselves as difficulties and complaints in their functioning that may need addressing (cf. Aoun et al., 2004 p. 34). Second, this basic need concept does nót constitute a 'need for care', but a need for achieving a satisfactory level of biopsychosocial functioning. Third, theoretically, unfulfilled basic needs point to a lack of well-being (Tay and Diener, 2011), which might (but need not) indicate an unmet need for care (Brewin, 1992). The concept unfulfilled need thus differs from the concept unmet need for care (Carr and Wolfe, 1976). Finally, it follows that the concept of unfulfilled basic needs does not involve an expressed demand for care, nor does it entail the absence or presence of supply. Felt needs are only a starting point for communication with the older adult about possible demands.

2.2. Population segmentation based on persons' difficulties in fulfilling biopsychosocial needs

The "Bridges to Health" model developed by Lynn et al. (2007) comes closest to what could be called person-centred segmentation. This model stratifies the entire healthcare population into eight segments in which all people, at any point in their live, fit in. The segments are labelled as: 1.) Healthy; 2.) Maternal and infant health; 3.) Acutely ill; 4.) Chronic conditions, normal functioning; 5.) Stable but serious disability; 6.) Short period of decline before dying; 7.) Limited reserve and exacerbations; and 8.) Frailty with or without dementia (Lynn et al., 2007). Segmenting the general population into these eight hypothetical groups based on health prospects and priorities is a major step towards a person-centred supply policy. However, this segmentation includes all ages, and the constructed segments encompassing older adults are too broad and include too much variety to be useful in redesigning (elderly care) supply. Further, the "Bridges to Health" model is conceptual and not based on primary data regarding people's felt difficulties in fulfilling their needs.

In considering elderly care more specifically, Lafortune et al. (2009a, 2009b) have been one of the very few who have attempted to segment older adults into more homogeneous groups. These authors proposed segmenting the elderly population still living in the wider community into four groups: 1.) Relatively healthy; 2.) Physically impaired; 3.) Cognitively impaired; and 4.) Cognitively and physically impaired. Variables used to define the segmentation included reported hypertension, stroke, diabetes, cancer, circulatory, respiratory, arthritis, stomach and bladder problems, sensory limitations, cognitive impairments, depression and disability

(Lafortune et al., 2009a, 2009b). Another segmentation study grouped older adults based on expert measurement of specific diseases, impairments and disabilities (Wieland et al., 2000). Grouping older adults based on objective diseases, impairments and disabilities overlooks the reality that adults' difficulties in their functioning are not only determined by their medical conditions but also by their mental condition, family circumstances, preferences and financial capacity (Berry and Bendapudi, 2007). Moreover, a cure-oriented segmentation may stimulate overtreatment instead of contributing to older adults' wellbeing. Consequently, it has been argued that older adults would benefit from a more holistic approach (Mead and Bower, 2000; Edvardsson et al., 2008) that acknowledges each individual's felt difficulties considering humans' basic biopsychosocial needs, i.e., a more person-centred approach.

2.3. Person-centred segmentation

In essence, a person-centred approach acknowledges each person as an individual with a potentially broad range of difficulties and complaints, i.e., not only biomedical. Further, a person-centred approach acknowledges the relevance of actively seeking the person's own viewpoint in making healthcare decisions (Mead and Bower, 2000; Sullivan, 2003). For care providers, this requires taking each person's unfulfilled needs, expectations and preferences concerning their wellbeing and illness as the starting point. Not only can this help care providers obtain and provide more valuable information and lead to more satisfying explanations of illnesses, but it can also help establish a consensus about further treatment through dialogue between person and care provider (Kiesler and Auerbach, 2006). Moreover, patients are reported to value person-centred attributes such as `humaneness', being treated as an individual, mutual trust and the sharing of information and time (Mead and Bower, 2000). Also, a person-centred segmentation could effectively serve as an outcome measure by the degree to which the needs are fulfilled, i.e., change in experienced difficulties) (McCrone and Strathdee, 1994).

For person-centred segmentation, a person-centred approach needs to be conceptualized. As argued above a person-centred approach focuses on the needs of persons and the extent in which these are fulfilled, rather than on diseases, impairments and disabilities. In ageing populations, it is especially the (growing) interdependencies between these needs as one ages that may complicate need-fulfilment, causing a person to experience (additional) difficulties and complaints. Also, a person-centred segmentation requires a holistic perspective in analysing the unfulfilled basic needs. A holistic perspective combines biological, psychological and social perspectives (Mead and Bower, 2000). Moreover, a person-centred segmentation approach includes the need fulfilment as experienced by the person themselves, and thus involves "subjective" difficulties and complaints. By explicitly incorporating person subjectivity in health assessments, the perspective of the person becomes more prominent in healthcare decision-making (Sullivan, 2003). Based on this conceptualization of a person-centred approach, the selection of a set of person-centred segmentation variables has to meet the following criteria:

1. Variables refer to the extent to which persons experience their needs are fulfilled (i.e., the experienced difficulties and complaints in their functioning).
2. Variables refer to holistic needs and cover the entire scope of human functioning (biopsychosocial).
3. Variables reflect the subjectively experienced difficulties and complaints in their biopsychosocial functioning (i.e., insider's

perspective), rather than the objective clinical needs (i.e., outsider's perspective).

Despite its apparent value, stratifying the elderly population based on their own experienced range of difficulties in their functioning has seldom been empirically demonstrated and reported in the literature, and then only in a limited way (Lillrank et al., 2010; Calkins and Sviokla, 2007). This is where our research aims to contribute to the literature. We analyse the difficulties a stratified sample of 2019 older adults experience in their biopsychosocial functioning and segment them using Factor Mixture Model (FMM) analysis. After successfully creating segmented groups, we proceed to evaluate the alignment between the experienced difficulties concerning biopsychosocial needs within a segment and their current healthcare utilization.

3. Research design and methods

3.1. Study setting

The segmentation sample included 2019 older adults from those aged 65–101 years living in the northern part of the Netherlands. Based on the Dutch Act on Medical Research Involving Human Subjects (WMO) each older adult included in this research, or an authorized representative, provided written informed consent after detailed description of the study. To ensure that all elderly subgroups were included, sampling was performed through 25 diverse healthcare and welfare organizations as well as elderly associations in urban and rural areas. During data collection, the individuals' living conditions, including temporary hospitalizations and nursing home stays, were monitored. If needed, organizations were asked to enlarge their sample or an additional organization was approached. Of the stratified sample, 35.4% lived independently, 26.7% were temporarily hospitalized, 22.3% lived in a retirement home, and 15.6% (temporarily) resided in a nursing home. In 2011–12, two population-based samples of older adults in three Dutch villages ($n = 1459$) and assisted living areas ($n = 3656$) were used for validation. Comparable measurement and analytic procedures were followed.

Members of the participating organizations received training in sampling, data collection and data entry. Data was collected between March 2010 and January 2011 and involved a self-assessment by the older adults. Nearly half of the 2019 participants (43.4%) were assisted in completing the questionnaire e.g., through the clarification of the questions and response options and determination of the appropriate pace. The organizations were compensated for their efforts in systematically sampling, approaching and assisting the sampled older adults, registering responses, and data entry. In 2011, researchers carefully checked the data entered using the paper versions of the questionnaires as back-up.

3.2. Data

To segment the older adults according to their unfulfilled biopsychosocial needs, we required indicators of these different functional domains. The indicators employed were selected from the following two validated instruments: the Groningen Frailty Indicator (GFI) (Slaets, 2006; Schuurmans et al., 2004) and INTERMED (Stiefel et al., 1999; de Jonge et al., 2001). The instruments were slightly adapted for self-assessment. Both the GFI and the INTERMED items cover the measurement of a wide range of (un)fulfilled biopsychosocial needs (Slaets, 2006). We selected the subscales 'biological' (5 items) and 'psychological' (5 items) from the INTERMED to measure a person's felt needs in the physical and

psychological domain of human functioning because these sub-scales were considered to be more extensive compared to the questions from the GFI covering these domains. More extensive scales cover more aspects of human functioning and thus better fit our holistic view. The subscale 'social' (3 items) from the GFI was used to measure a person's felt need in the social domain of human functioning, because this subscale better fits our conceptualization of the need concept compared to the INTERMED subscale 'social'. Compared with the INTERMED, the GFI involved additional items to measure a person's felt need in the 'mobility' (4 items) and 'cognitive' (1 item) domains of human functioning. These items were also selected for the segmentation as they reflect felt needs that are typical for the population under study and fits our holistic perspective. These indicators for felt difficulties in the physical, psychological, social and cognitive domains of human functioning had ordinal response options, and the indicator for the mobility domain had nominal response options. There were no missing values. Appendix 1 provides an overview of the indicators and their measurement.

Afterwards, the segments found were further characterized by analysing the differences in gender, age, living arrangements, and preferred decisional control between segments (inactive co-variates). Preferred decisional control was measured using a three item-scale. A higher score indicates one's preference for being more actively involved in one's own healthcare consumption decisions. Finally, healthcare provider utilization was measured by a multi-response question on the types of care providers respondents are currently seeing.

3.3. Data analysis

This study applies a Factor mixture model (FMM) in which a confirmatory factor analysis and a Latent class analysis are combined. This factor model is designed to investigate the common content of observed scores of the items measuring the (un)fulfilled needs in the physical, psychological, social, mobility, and cognitive domains of human functioning. The measurement level of each item is given, based on which a factor per domain is specified to model the common content of these observed variables (Lubke and Muthen, 2005). Whereas latent class models serve to cluster participants. This type of combined modelling is adequate if the sample consists of different subtypes and it is not known beforehand which participant belongs to which of the subtypes (Lubke and Muthen, 2005).

As our aim of the data analysis is to see whether we can identify robust groups of older adults who respond similarly to questions about their experienced needs, the main interest of our analysis is the result of the latent class analysis. We used Latent Gold 4.5 to perform a finite mixture variant of an FMM in which only the factor means differ across latent classes (Vermunt and Magidson, 2005). Older adults were then assigned to a segment or "latent class" based on their posterior membership probabilities: they were assigned to the segment for which they had the highest probability. The advantages of latent class analysis over more traditional ad-hoc cluster analysis include model selection criteria and probability-based classification (Vermunt and Magidson, 2008; Magidson and Vermunt, 2002; Lafortune et al., 2009b).

We fit FMM successively for 1 through 6 latent classes, and we assessed model fit using multiple criteria. We used the L^2 likelihood-ratio statistic to assess the amount of association among the indicators that remained unexplained after estimating the model (a lower value indicates a better fit of the model to the data) (Vermunt and Magidson, 2008). We also used the Bayesian Information Criterion (BIC) to assess model fit based on likelihood. A smaller BIC indicates a better fit (Vermunt and Magidson, 2008;

Magidson and Vermunt, 2004). Subsequently, we described the segments using data on additional variables (see above) in SPSS, and the healthcare provider utilization was analysed per elderly segment. Segment differences were tested with one-way ANOVA and Dunnett's C post hoc test ($p < 0.05$).

4. Results

The average age of the sample was 79 years and 4 months (standard deviation 7.80), ranging from 65 to 101 years. Table 1 shows the gender distribution and living conditions. The living conditions distribution differs from the stratified sample as a result of including older adults who were temporarily residing in a hospital or nursing home.

The comparison of model fit statistics for the FMM with 1 through 6 latent classes (Appendix 2) showed that increasing the number of classes resulted in a reduction of L^2. Additionally, the BIC suggested that the 5-class model best fit the data (BIC: 52836,96). Table 2 shows the relationships between the elderly segments and the items reflecting the respondents' experienced difficulties in fulfilling their biopsychosocial needs. The columns represent the segment-specific item probabilities. For example, the first segment is characterized by the highest probabilities of experiencing fulfilled needs in all domains of human functioning (e.g., fulfilled needs concerning chronicity $\lambda = 0.9263$) compared to the other segments. A label was assigned to each segment based on the comparisons of conditional item probabilities. Based on these probabilities and the additional data concerning gender, age, living condition and decisional control, we provide a brief description of each segment below. In the replication studies the 5-class model, as described below, always fit the data best and they provide similar results in segment's characteristics. Below three percentages are shown for each segment. The first is based on the sample of the 2019 older adults, the second and third on the two population-based replication studies ($n = 1459$ and $n = 3656$ resp.).

Feeling vital (8%/29%/31%) – With a mean age of 76, the persons in this segment that we labelled 'vital' felt they were healthy ageing and did not experience difficulties in their biopsychosocial functioning. .

Difficulties with psychosocial coping (13%/20%/14%) – With a mean age of 79, the older adults within this segment experienced some difficulties in fulfilling their needs, most specifically or even exclusively in their psycho-social functioning. These older adults felt as though they were getting older, experienced sometimes feelings of loneliness and coping difficulties and were not necessarily comfortable with ageing.

Physical and mobility complaints (45%/30%/11%) – With a mean age of 78, the persons within this segment experienced difficulties in their functioning, mainly concerning their physical and mobility needs. . While these older adults typically experienced difficulties in their physical functioning, the majority believed their condition

Table 1
Sample characteristics ($n = 2019$).

	n	%
Gender		
Female	1234	61.1
Male	785	38.9
Living conditions		
Independent with partner/relatives	783	38.8
Independent alone	434	21.5
Retirement home with partner/relatives	83	4.1
Retirement home alone	499	24.7
Nursing home	204	10.1
Other	16	0.8

Table 2
Probability distribution of items per elderly segment.

		1. Feeling vital	2. Difficulties with psychosocial coping	3. Physical and mobility complaints	4. Difficulties experienced in multiple domains	5. Feeling extremely frail
		λ (probability that response is associated with elderly segment)				
Physical needs[a]						
Chronicity	0	0.9263	0.2968	0.132	0.0405	0.027
	1	0.0662	0.2804	0.211	0.1143	0.0901
	2	0.0072	0.3094	0.4011	0.3843	0.3603
	3	0.0003	0.1135	0.2559	0.4609	0.5226
Diagnostic dilemma	0	0.8181	0.2935	0.1735	0.0867	0.0691
	1	0.177	0.5664	0.5738	0.5011	0.4679
	2	0.0048	0.1311	0.2262	0.3428	0.3745
	3	0	0.0091	0.0265	0.0693	0.0885
Severity of problems	0	0.9256	0.3985	0.2227	0.095	0.0708
	1	0.0717	0.4024	0.3967	0.2979	0.2603
	2	0.0026	0.1619	0.2734	0.36	0.3695
	3	0.0001	0.0373	0.1072	0.247	0.2994
Diagnostic problems	0	0.9632	0.8442	0.7692	0.6568	0.618
	1	0.0336	0.1046	0.1306	0.1533	0.1577
	2	0.0027	0.0296	0.0504	0.081	0.0909
	3	0.0006	0.0216	0.0498	0.1089	0.1333
Complications and life threat	0	0.8739	0.5378	0.4125	0.2846	0.2509
	1	0.1188	0.3521	0.3977	0.4086	0.4032
	2	0.0071	0.1002	0.1658	0.2528	0.2792
	3	0.0002	0.0099	0.0239	0.054	0.0667
Psychological needs[b]						
Restrictions in coping	0	0.8868	0.7356	0.7645	0.5456	0.2998
	1	0.1022	0.2065	0.1895	0.2833	0.2956
	2	0.0085	0.0376	0.0309	0.0894	0.1597
	3	0.0025	0.0202	0.0152	0.0816	0.245
Psychiatric dysfunction	0	0.8784	0.6459	0.6881	0.3752	0.138
	1	0.099	0.2134	0.1981	0.2825	0.1927
	2	0.0202	0.1176	0.0972	0.2433	0.373
	3	0.0023	0.023	0.0166	0.099	0.2964
Resistance to treatment	0	0.8864	0.8052	0.82	0.7058	0.554
	1	0.0818	0.1179	0.1123	0.148	0.1719
	2	0.0283	0.0644	0.0574	0.1148	0.196
	3	0.0035	0.0125	0.0104	0.0314	0.0781
Psychiatric symptoms	0	0.9776	0.8579	0.8871	0.6587	0.3086
	1	0.0215	0.1302	0.1042	0.2728	0.4283
	2	0.0009	0.01	0.0075	0.0566	0.1592
	3	0	0.002	0.0012	0.0118	0.1039
Mental health treat	0	0.7762	0.6413	0.6638	0.5078	0.3468
	1	0.2069	0.3111	0.2951	0.3923	0.4473
	2	0.0158	0.0428	0.0373	0.0851	0.1602
	3	0.001	0.0048	0.0038	0.0148	0.0456
Social needs						
Experience emptiness around him/her	No	0.9999	0.5335	1	0.5836	0.7326
	Sometimes	0.0001	0.4361	0	0.3936	0.2594
	Yes	0	0.0304	0	0.0228	0.0081
Miss people around him/her	No	1	0.6471	1	0.7162	0.8772
	Sometimes	0	0.3072	0	0.2566	0.1167
	Yes	0	0.0457	0	0.0272	0.006
Feel left alone	No	0.9931	0.6304	0.9972	0.6576	0.7379
	Sometimes	0.0069	0.2842	0.0028	0.269	0.2187
	Yes	0	0.0855	0	0.0735	0.0434
Mobility needs						
Whether the older adult can do the following activities independently:	Grocery shopping	0.9396	0.9004	0.7159	0.4066	0.3066
	Walk outside the house	0.9891	0.9819	0.8315	0.5706	0.3754
	Getting (un)dressed	0.9857	0.9728	0.8484	0.5859	0.444
	Visiting restroom	0.996	0.9914	0.9441	0.7463	0.6525
Cognition needs						
Experience complaints about memories	No	0.7262	0.5962	0.6505	0.502	0.0492
	Sometimes	0.2465	0.3418	0.3041	0.3993	0.3137
	Yes	0.0272	0.0619	0.0454	0.0988	0.6371

[a] Physical needs: score on the items of the sub-scale physical complexity of INTERMED: 0 is "fulfilled needs", 1 is "some unfulfilled needs", 2 is "unfulfilled needs", 3 is "severe unfulfilled needs".
[b] The same scaling is used as for physical needs.

would either improve, or remain stable over the next six months. Consequently, these older adults felt they could still fulfil their needs in the other domains and did not feel lonely or abandoned.

Difficulties experienced in multiple domains (22%/17%/34%) — These older adults have a mean age of 80 years and experienced difficulties in their functioning with respect to various functional domains. As a result, more than half (53.2%) of the older adults in this segment does not live independently anymore.

Feeling extremely frail (13%/5%/9%) — This segment includes very frail persons who face enormous difficulties in their overall

Table 3
Characteristics per elderly segment.

	1.Feeling vital	2. Difficulties with psychosocial coping	3.Physical and mobility complaints	4.Difficulties experienced in multiple domains	5.Feeling extremely frail
Demographics					
Age mean (standard deviation)[a]	75.8 (7.2)	78.9 (7.4)	78.3 (7.9)	80.0 (7.8)	82.3 (7.0)
Male %	50%	51%	39%	31%	34%
Female %[a]	50%	49%	61%	69%	66%
Preferred decisional control (0–4) mean (standard deviation)[b]	3.1 (0.7)	3.1 (0.7)	2.8 (0.9)	2.5 (1.1)	1.6 (1.4)
Living conditions[a]					
Independent, with partner/relative	59%	39%	44%	28%	18%
Independent, alone	22%	25%	23%	19%	15%
Retirement home	16%	30%	27%	36%	36%
Nursing home	3%	5%	6%	16%	30%

[a] Only segment 3 and 4 do not differ significantly ($p < 0.05$).
[b] Segment 5 differs significantly from all other segments ($p < 0.05$) and segment 2 does not differ significantly from segment 5 ($p < 0.05$).

functioning and are thus faced with a situation in which many basic needs of human beings are unfulfilled. . The older adults in this segment are the oldest with a mean age of 82. The severe difficulties they experienced concern most domains of their functioning and daily activities. The majority complained about their memory (88%) and reported feeling lonely (85%), i.e., unfulfilled social needs.

To enrich this description Table 3 provides additional data on each segment's mean age, gender representation, living conditions and preferred decisional control. While the grouping is not based on these additional variables, most variables show significant differences across the segments.

4.1. Healthcare utilization per elderly segment

Fig. 1 summarizes the healthcare utilization per segment, i.e., the care provided by seven care provider categories, as specified by the respondents. Fig. 1 shows how the number of care provider categories involved increases as the intensity of the experienced difficulties increases. The majority of each segment received care from their General Practitioner (GP). Understandably, older adults with 'physical and mobility complaints' and 'difficulties experienced in multiple domains' receive significantly more often physiotherapist care ($p < 0.05$) compared to the first two segments. Surprisingly, those in the segment 'Difficulties in psycho-social coping' hardly received any help of e.g., psychologists or social workers.

5. Conclusion

Our FMM-based segmentation of a stratified sample of Dutch older adults demonstrates that despite the confirmed heterogeneity in experienced difficulties in and complaints about their biopsychosocial functioning (Boult and Wieland, 2010; Fried et al., 2001; Slaets, 2006), these unfulfilled needs do form patterns. The older adults in our study can be clustered into five relatively homogeneous groups to which each respondent could be assigned with a known probability. These segments were labelled 'Feeling vital', 'Difficulties with psychosocial coping', 'Physical and mobility complaints', 'Difficulties experienced in multiple domains', and 'Feeling extremely frail'. Our findings offer convincing empirical validation for earlier proposals to segment populations based on felt needs (Lynn et al., 2007). Second, this study yields a set of person-centred variables that could be used in a first triage step, and offers more contextual information than purely disease-based information. Below, we reflect on the study's strengths and weaknesses, but we first discuss how this person-centred segmentation may advance clinical practice and feed a key debate in healthcare policy.

5.1. Segments' usefulness

In clinical practice the five elderly segments can be used as a first triage step. Care providers can — through the 18 core items used for segmentation (Appendix 1) — quickly gather context information
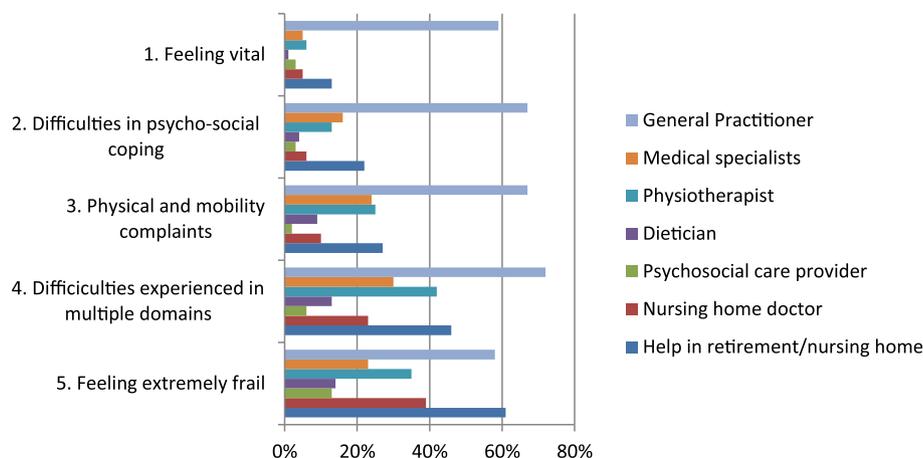

Fig. 1. Healthcare utilization per segment.

on a person, in terms of the segment to which the person most likely belongs. Subsequently, in a second triage step a comprehensive assessment can be conducted focussing on the particular difficulties experienced (e.g., too little social contacts and activities) and risks (e.g., risk of falling) typical for the specific segment. This might have two main advantages. First, knowing an older adult's segment offers care providers contextual information, which may be helpful to interpret the symptoms the person expresses and to discuss the implications of a diagnosis with the older adult. More importantly, the segment-based information offers a starting-point for providing more person-centred care, for starting to talk about unfulfilled needs instead of symptoms and diseases. As Box 1 shows, such information may stimulate the two-way communication needed between a person and care provider for establishing partnership and consensus about treatment and care (Little et al., 2001). Second, knowing the segments and their particular characteristics might result in developing focused and coherent diagnostic packages in second-step triage which contributes to a more time-efficient triage instead of long assessments involving all impairments and risks. The multiple-step triage proposed provides a balanced answer to the debate whether the use of a comprehensive assessment for a specific elderly segment, or a short questionnaire screening of all older adults would be more cost-effective.

At a policy level, segmentation based on experienced difficulties can help to (re)allocate resources in a demand-driven manner (Rijckmans et al., 2007) and evaluate resource utilization and its effectiveness (Taylor et al., 2010). Healthcare organizations or insurance companies for instance may screen their older adults, using this shortlist, in order to analyse their own local or regional elderly population's distribution over the segments. This may serve as input for aligning the experienced unfulfilled needs of their older adults and the practice's supplies. For example, in our sample we found that older adults in the segment '*Difficulties in psychosocial coping*' often did not report to have received psychosocial care from e.g., a psychotherapist or social worker. One explanation for this might be the Dutch GP-role. GPs act as gatekeepers to more specialist care, and may also provide some psychosocial care themselves. Other explanations for the low utilization of

psychosocial care services in this segment might be (cultural) restraints in bringing up the (unfulfilled) need for psychosocial well-being, relatively low access to and acceptance of psychosocial care, or physicians limited sensitivity to patient affect (Gulbrandsen et al., 2012). This shows how the segmentation can support in assessing alignment issues. Box 2 provides a description of how the person-centred segmentation is used on a policy level to develop a new portfolio of care and services in an ambulatory care centre in The Netherlands.

Next to supporting the development of healthcare services that are aligned to the experienced difficulties in the person's functioning within a segment, the current segmentation may also help in selecting which care management model can be best utilized (Lillrank et al., 2010). For example, a 'case manager'-model to coordinate care (Gravelle et al., 2007) seems less appropriate for the first three segments, as these older adults experience relatively few interrelated difficulties and in at most one domain of their functioning. On the other hand, the elderly segments which are characterized by more complex interrelations between experienced difficulties in the person's functioning might benefit from active case management.

The assumption is that within one segment, individuals will have a percentage of shared difficulties in fulfilling biopsychosocial needs, enabling forms of customization at relatively low costs (De Blok et al., 2010), e.g., modularity in the design of elderly care is gaining attention (De Blok et al., 2010), see also Box 2. Per segment, a set of care and service modules could be developed. Whether the five segments currently developed are sufficiently homogenous to support a modular design is a topic for future study. Another area for further research concerns individuals' transition paths (Lafortune et al., 2009b) between the segments and the

Box 1

Use of a person-centred segmentation on an individual client level.

A GP practice in The Netherlands experienced the need to gain more holistic insights into the unfulfilled needs of its elderly clients. First of all, this practice wanted to know if they could provide more preventive care and secondly, to trace hidden unfulfilled needs. The GP used the list of questions that were applied for developing the person-centred segmentation to screen the older clients (65 years or older) of their practice. This screening showed that the segment 'Difficulties with psychosocial coping' was relatively large and included individuals from whom the GP did not know that they experienced psycho-social difficulties. A specialized nurse in mental health visited these older adults at their homes. During the house visits, the screening was used as a tool to enable a two-way conversation about the unfulfilled needs of the older person rather than the disease related symptoms. The screening resulted in an improved understanding of what clients expressed as their unfulfilled needs, and the interactions between different experienced difficulties and complaints.

Box 2

Use of a person-centred segmentation on a policy level.

A multidisciplinary task force within an ambulatory elderly care centre in The Netherlands received the assignment to develop an innovative care and service portfolio which reflects a balance between person-centred care and low costs. Next to employees of the centre, chain partners with whom they closely cooperated, like GP practices and homecare, also participated in this task force. The segments 'difficulties with psycho-social coping' and 'physical and mobility complaints' were used as a starting point. The task force formulated goals they wanted to achieve for the functioning of the persons in these segments, like "maintain social network" and "improved mobility". Based on these goals participants developed modules that many elderly from this segment might help fulfilling their needs. Modules are integrated care packages which consist of elements which are interdependent and together fulfil a clear function (De Blok et al., 2010). Examples of modules were "stay save and balanced-module" and "stay more self-reliant-module". Using the segments as a starting point resulted in more person-centred care as the modules express the value that clients could obtain from a module. Also, the modules could be mixed and matched, so that a wide variety of care and service packages could be created. The modular care enhanced efficiency in terms of coordination effort per individual client, as the contributions from multiple providers are integrated and standardized in a module.

explanatory factors involved. One specific question in such research would be whether living conditions influence these transitions.

5.2. Strengths and weaknesses

The current study's strengths include the large and heterogeneous sample in terms of age and living conditions. The validity of the initial segmentation was confirmed in the two subsequent population-based samples in The Netherlands as each time it yielded the same number and nature of segments.

Furthermore, as the data was gathered through self-assessment, the results revealed the difficulties in fulfilling felt biopsychosocial needs as experienced by older adults themselves. To the extent that previous segmentation studies have been conducted, they utilized disease and constraint data (Lafortune et al., 2009a, 2009b; Wieland et al., 2000), and the unfulfilled needs experienced by older adults themselves have rarely been taken into account. Additionally, due to our biopsychosocial needs perspective, we distinguished the meaningful segment, 'Difficulties with psychosocial coping', which did not come to the fore when primary data on medical condition was used (Lafortune et al., 2009a, 2009b). Future research might compare these two kinds of segmentation and their utility. Moreover, the relation between a subjective segmentation and a normative segmentation, such as the WHO International Classification of Functioning needs further research.

The study's limitations should also be considered. First, articulating one's needs and the extent to which they are unfulfilled is difficult, particularly for the very frail older adults (Murphy et al., 2005). Moreover, segmenting people based on their unfulfilled articulated needs might not be an obvious approach in healthcare. With validated scales and by offering support in filling out the questionnaire (Slaets, 2006; Schuurmans et al., 2004; de Jonge et al., 2001), we attempted to overcome these measurement problems.

Second, our data collection was restricted to one European region. The study and its two replications revealed that it is empirically possible to segment older adults into five meaningful groups, but the distribution over these segments may differ across populations. For example, in our stratified sample certain living conditions may have been overrepresented, which will influence the distribution over these segments. Fourth, this research considers the full range of difficulties experienced by an older adult; however their strengths are not considered. Future segmentation research might also incorporate the older adults' experienced strengths. Repeat an FMM with variables that also involve people's strengths may also improve the model fit statistics. In the current model, the classification error is rather high (0.22), indicating a chance that a person is assigned to the wrong segment. Taking the probability pattern for the five segments into regard lowers this risk and offers more nuances. Moreover, future research could focus on the required level of sensitivity and specificity in order to develop more person-centred care. The current study offers empirical evidence for the possibility to segment older adults into five meaningful groups of individuals with similar unfulfilled biopsychosocial health-related needs. Replication studies in other regions in the world may provide further external validation. This outcome is a significant step on the road towards combining efficient and demand-driven elderly care may be attainable.

Acknowledgements

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.socscimed.2014.05.012.

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